

The background of the entire page is a photograph of a lake. In the foreground, there are numerous lily pads floating on the water. To the left and in the center, there are tall, green reeds or grasses growing out of the water. The water is calm, reflecting the sky and the surrounding vegetation. In the distance, a line of trees is visible under a bright sky.

# **LAKE CLASSIFICATION SHORT REPORT ON CROOKED LAKE ADAMS COUNTY, WI**

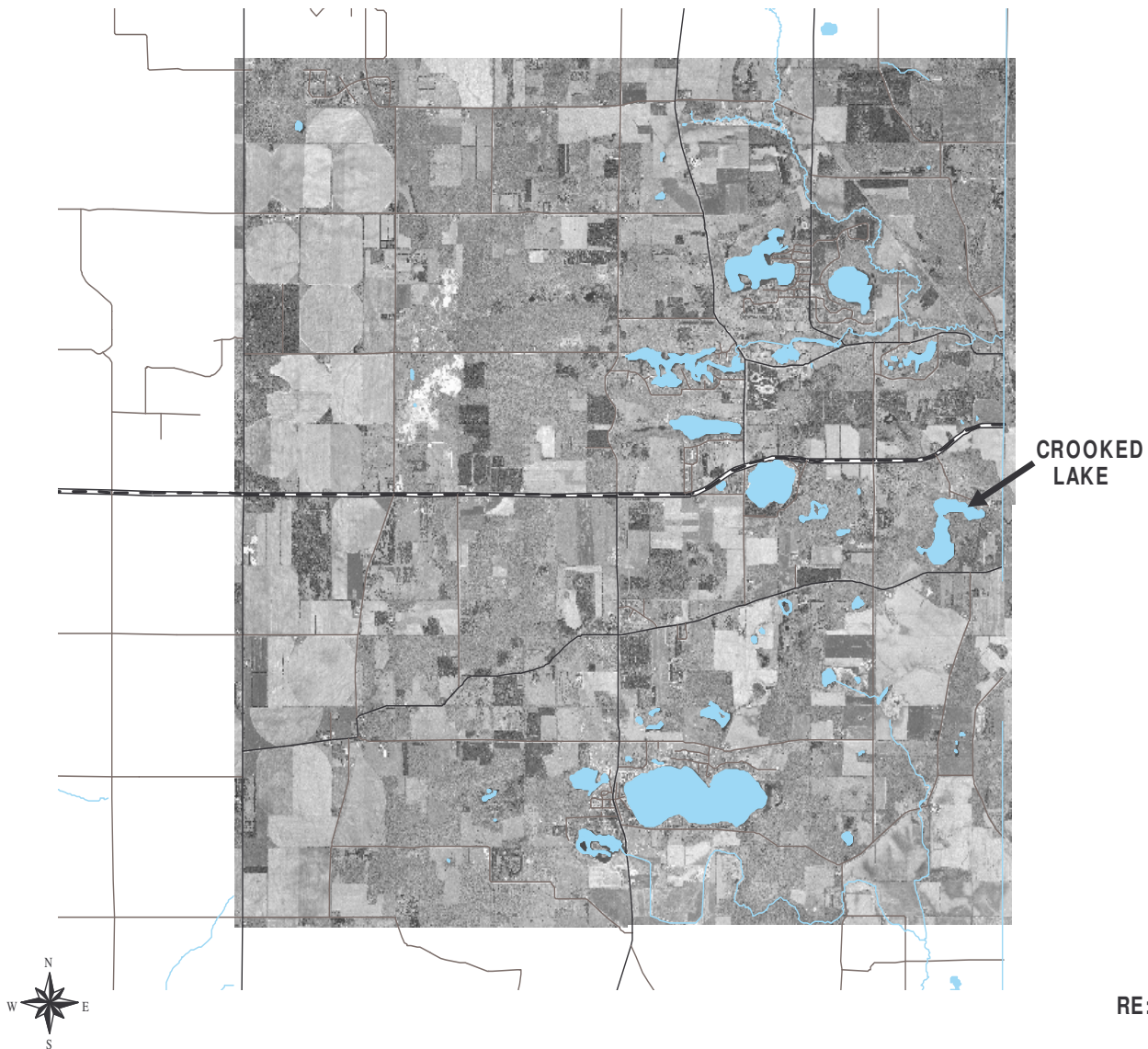
**Prepared by Reesa Evans, Lake Specialist, CLM  
Adams County Land & Water Conservation Department  
P.O. Box 287, Friendship, WI 53934**

**AUGUST 2007**

24 9:28 AM

# Introduction

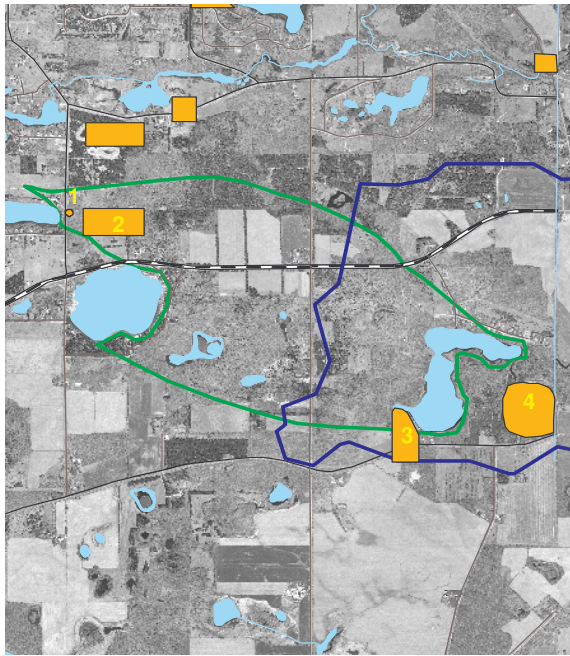
**Information about Crooked Lake:** Crooked Lake is located in the Town of Jackson, Adams. It is a natural seepage lake with good to very good water quality and clarity. As in the case in all seepage lakes, the water level on Crooked Lake fluctuates naturally with the underground water table. Crooked Lake has 48 surface acres, with a maximum depth of 56 feet and a mean depth of 14 feet. The Wisconsin Department of Natural Resources has designated Crooked Lake as an outstanding waterbody with a forested wetland corridor on the western/southwestern part of the lake that extends over 500' inland from the ordinary high water mark of the lake. Currently, Crooked Lake is the only lake so designated in Adams County. There is a public boat ramp on the north side of the lake.





# Archeological Sites

## Crooked Lake Archeological Sites



- Surface Watershed Boundary
- Ground Watershed Boundary
- Water
- Section Lines
- Archeological Sites\*

- 1: Isolated find of chert thinning flakes
- 2: Unnamed mound burials: 12 conical, linear & effigy
- 3: Crooked Lake Mound Group: effigy mounds of 3 birds, 1 short-tailed quadruped, 6 linear, 5 oval--human skull found on site
- 4: Unspecified burials from gravel knoll



RE:4/05; revised 7/06

\*information from Wisconsin Historical Society



Conical mound

There are many Native American archeological sites in Adams County, with four located right around Crooked Lake. Burials mounds are found in conical shapes, linear shapes or effigy shapes (animal shapes). In order to preserve Native American Heritage, both federal and state acts on Native American burials prohibit these sites from being further disturbed without permission of the federal government and input from the local tribes.

# Land Use

Both the surface and ground watersheds of Crooked Lake are fairly small. Studies have shown that lakes are products of their watersheds, and that land use around has a great impact on the water quality of that lake, especially in the amount and content of stormwater runoff. Natural undisturbed landscapes tend to have low stormwater runoff levels.

Land use categories in acreage and percent of total are:

	Surface		Ground		Total	
<b>Crooked Lake</b>	<b>Acres</b>	<b>% of Total</b>	<b>Acres</b>	<b>% of Total</b>	<b>Acres</b>	<b>% of Total</b>
Agriculture--Non Irrigated	735	47.50%	142.89	22.29%	877.89	40.12%
Government	3.56	0.23%	0	0.00%	3.56	0.16%
Residential	202.55	13.09%	104.45	16.29%	307	14.03%
Water	58.8	3.80%	71.4	11.14%	130.2	5.95%
Woodland	547.58	35.38%	322.26	50.28%	869.84	39.74%
total	1547.37	100.00%	641	100.00%	2188.37	100.00%

Slightly over 47% of the surface watershed for Crooked Lake is non-irrigated agriculture. Agriculture may contribute significantly to the amount of nutrients in water. It is important to reduce this contribution as much as possible.

Woodlands are the second largest land use category in the Crooked Lake surface watershed. Since forest floors are often full of leaves, needles and other duff, runoff from forested lands may be more filtered than runoff from agricultural or residential lands.

Residential land use is the third most common land use category in the Crooked Lake surface watershed, especially around the lake itself. This land use category may also contribute nutrients to the water from stormwater runoff, mowed lawns and impervious surfaces. This nutrient source should also be reduced as much as possible.

The primary land uses of the ground watershed of Crooked Lake are woodlands and non-irrigated agriculture.

There are several wetlands around the shores of Crooked Lake. Wetlands play an important role in water quality by trapping many pollutants in runoff waters and by serving as buffers to catch and control what would otherwise be uncontrolled water and pollutants. Wetlands also play an essential role in the aquatic food chain, thus affecting fishery, and also serve as spaces for wildlife habitat, wildlife reproduction & nesting, and wildlife food. There are several wetlands at or near Crooked Lake's shore. It is essential to preserve these wetlands for the continued health of Crooked Lake waters.



**Wetlands on the shore  
of Crooked Lake**

Like many lakes in Wisconsin, Crooked Lake is a phosphorus-limited lake. This means of the pollutants ending up in the lake, the one in the shortest supply and most affects the overall quality of the lake water is phosphorus. Land use types play a major role in determining the amount of phosphorus being loaded into the lake. Based on recent statistics and computer modeling, currently both the ground watershed and non-irrigated agriculture are the greatest contributors of phosphorus to Crooked Lake

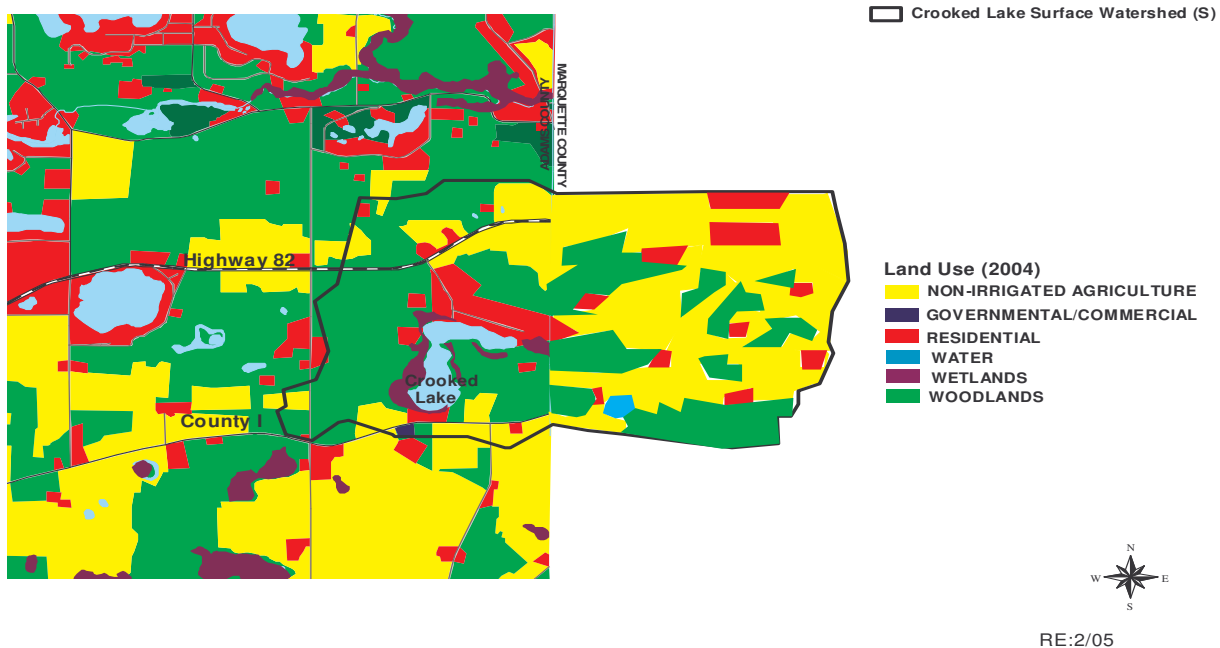
Some aspects of phosphorus loading can't be modified by human behavior—they are simply part of the natural landscape. However, phosphorus loading from agriculture, residential and septic use of the land can be decreased or increased by human activity.

<b>PHOSPHORUS LOADING</b>	<b>Most</b>	<b>Likely</b>
<b>Land Use Type</b>	<b>lb/yr</b>	<b>% total load</b>
<u>Non-Point Sources</u>		
Non-Irrigated Agriculture	261.8	74.0%
Residential	6.6	2.0%
Woodlands	22.0	6.2%
Government	2.2	0.1%
Groundwatershed	28.6	8.1%
Lake Surface	8.8	2.2%
Septic Systems	26.1	7.4%
total loading in pounds/year	356.1	100.0%

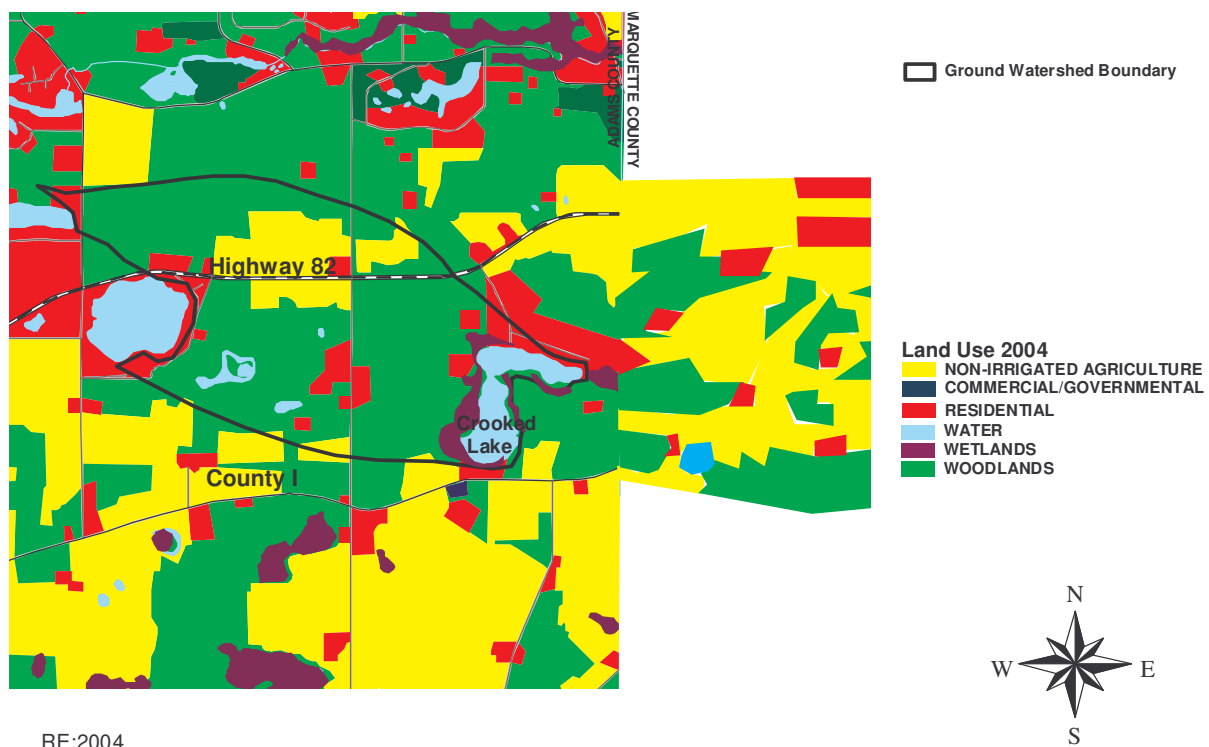
Even slight decreases in the phosphorus input from agriculture, residential and septic land use can make a big difference in phosphorus loading. A 10% decrease in these loads would reduce overall phosphorus loading by 32.28 pounds. Since one pound of phosphorus can produce up to 500 pounds of algae per year, a reduction of 32.28 pounds of phosphorus could mean 16140 **fewer** pounds of algae per year!

<b>Land Use Type</b>	<b>-10%</b>	<b>-25%</b>	<b>-50%</b>
<u>Non-Point Sources</u>			
Non-Irrigated Agriculture	235.62	196.35	130.90
Residential	5.94	4.95	3.30
Woodlands	22	22.00	22.00
Government	2.2	2.20	2.20
Groundwatershed	25.74	21.45	14.30
Lake Surface	8.8	8.80	8.80
Septic Systems	23.52	19.60	13.07
total loading in pounds/year	323.82	275.35	194.57

# SURFACE WATERSHED LAND USE



# Crooked Lake--Ground Watershed Land Use





# Shorelands

Crooked Lake has a total shoreline of 2.2 miles (11,616 feet). Much of the shore has been left unaltered. Most of the areas near the south shore are steeply sloped. The rest of the shore is flatter. Buildings are generally located 70 or more feet back from the shore except at the north end of the lake. There is a public boat landing on the north lobe of the lake.

93% of Crooked Lake's shoreline is naturally vegetated. The remaining 6% is mowed lawn.

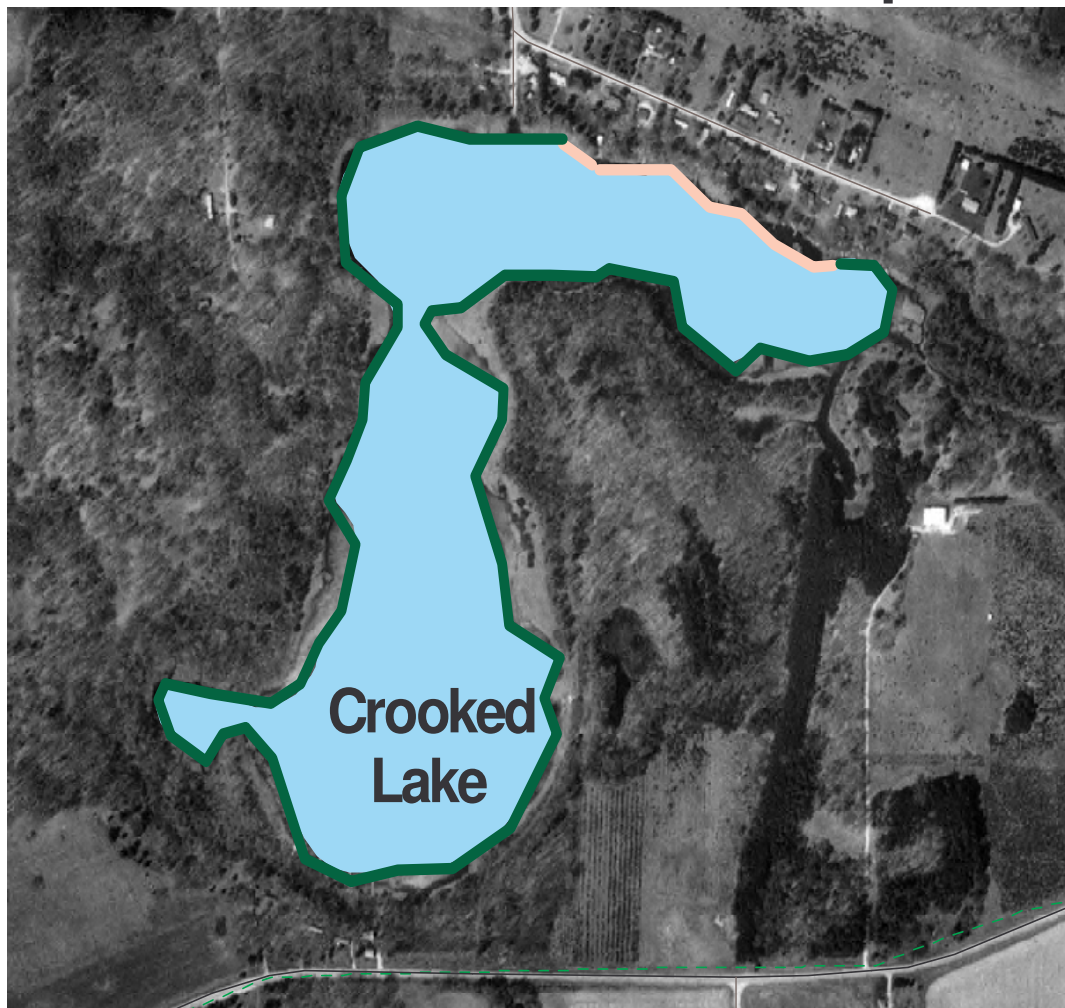
## Shoreline Map--Crooked Lake





A 2004 shore survey showed that a most of the shore had an “adequate buffer.” An “adequate buffer is as a native vegetation strip at least 35 feet landward from the shore. However, parts of the north shore had an inadequate buffer. Most of the “inadequate” buffer areas were those with mowed lawns and insufficient native vegetation at the shoreline to cover 35 feet landward from the water line.

## Crooked Lake--Buffer Map



RE:4/05

 Adequate Buffer  
 Inadequate Buffer



Shoreland buffers are an important part of lake protection and restoration. These buffers are simply a wide border of native plants, grasses, shrubs and trees that filter and trap soil & similar sediments, fertilizer, grass clippings, stormwater runoff and other potential pollutants, keeping them out of the lake. A 1990 study by the Wisconsin Department of Natural Resources of Wisconsin shorelines revealed that a buffer of native vegetation traps 5 to 18 times more volume of potential pollutants than does a developed, traditional lawn or hard-armored shore. The filtering process and bank stabilization that buffers provide help improve or maintain a lake's water quality and clarity.



**Example of Inadequate Buffer**



**Example of Adequate Buffer**

Vegetated shoreline buffers help stabilize shoreline banks, thus reducing bank erosion. The plants roots give structure to the bank and also increase water infiltration and decrease runoff. A vegetated shore is especially important when shores are steep and sandy, as are many at Crooked Lake.

# Water Quality Information

One of the measures Wisconsin uses to give a general estimate of a lake's water quality is the **trophic state index**. This index looks at a lake's water clarity, its amount of total phosphorus (the element most related to aquatic plant and algal growth), and its chlorophyll-a level (chlorophyll-a is a pigment used by algae for photosynthesis).

Depending on the trophic index score, lakes are then classified as **Oligotrophic** (good), **Mesotrophic** (fair), or **Eutrophic** (poor):

- **Good:** Oligotrophic lakes have clear, deep water with few algal blooms. Larger game fish are often found in such lakes.
- **Fair:** Mesotrophic lakes have more aquatic plant and algae production, with occasional algal blooms and a good fishery. The water is usually not as clear as that of oligotrophic lakes.
- **Poor:** Eutrophic lakes are very productive, with lots of aquatic plants and algae. Algal blooms are often frequent in these lakes. They may have a diverse fishery, but rough fish (such as carp) are also common. Water is often cloudy or murky. Small shallow lakes are more likely to be eutrophic.

Score	<u>TSI Level Description</u>
30-40	<b><u>Oligotrophic:</u></b> clear, deep water; possible oxygen depletion in lower depths; few aquatic plants or algal blooms; low in nutrients; large game fish usual fishery
40-50	<b><u>Mesotrophic:</u></b> moderately clear water; mixed fishery, esp. panfish; moderate aquatic plant growth and occasional algal blooms; may have low oxygen levels near bottom in summer
50-60	<b><u>Mildly Eutrophic:</u></b> decreased water clarity; anoxic near bottom; may have heavy algal bloom and plant growth; high in nutrients; shallow eutrophic lakes may have winterkill of fish; rough fish common
60-70	<b><u>Eutrophic:</u></b> dominated by blue-green algae; algae scums common; prolific aquatic plant growth; high nutrient levels; rough fish common; susceptible to oxygen depletion and winter fishkill
70-80	<b><u>Hypereutrophic:</u></b> heavy algal blooms through most of summer; dense aquatic plant growth; poor water clarity; high nutrient levels

**Crooked Lake's overall TSI is 45**





Water clarity readings are usually taken by using a Secchi disk (shown at right). **Average summer Secchi disk clarity in Crooked Lake in 2004-2006 was 10.6 feet.** Water clarity in Crooked Lake has remained in the “very good” clarity category since 1992. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water.

Increased phosphorus levels in a lake will feed algal blooms and also may cause excess plant growth. **The 2004-2006 summer average phosphorus concentration in Crooked Lake was 18.8 micrograms/liter.** This is below the 25 micrograms/liter average for natural lakes in Wisconsin. However, phosphorus levels at the bottom have been elevated, so phosphorus needs to be monitored.



The third measure used in trophic state classification is the amount of chlorophyll-a contained in the lake. The amount of chlorophyll-a found in a lake is an indication about the amount of algae in the lake. **The 2004-2006 summer average chlorophyll-a concentration in Crooked Lake was 4.4 micrograms/liter.** This level of chlorophyll-a gives Crooked Lake a “very good” ranking for chlorophyll-a (i.e., it’s very low). Since 1992, Crooked Lake’s chlorophyll-a levels have remained very low.

# In-Lake Habitat

## Aquatic Plants

A diverse aquatic plant community plays a vital role in improving water quality, providing valuable habitat resources for fish and wildlife, resisting invasions of non-native species and checking excessive growth of the most tolerant species.

An aquatic plant survey was performed in 2005. The 0-1.5ft depth zone supported the most abundant aquatic plant growth. The Crooked Lake aquatic plant community is characterized by high quality and excellent species diversity. *Chara* spp (muskgrass), and *Nymphaea odorata* (white water lily) were the most common aquatic species.

Important to maintaining a high quality, diverse aquatic plant community is an integrated aquatic plant management plan that controls the invasive plants in the lake. The only invasive exotic in Crooked Lake found in 2005 was *Myriophyllum spicatum* (Eurasian watermilfoil), which was found in only two places on the lake in small amounts. Invasive plants not found were *Potamogeton crispus* (Curly-Leaf Pondweed) and *Lythrum salicaria* (Purple Loosestrife), although these are found at several lakes near to Crooked Lake.

More detailed information can be found in the aquatic plant report of the 2005 survey, available on request from the WDNR or Adams County Land & Water Conservation Department.



**Curly-Leaf Pondweed**

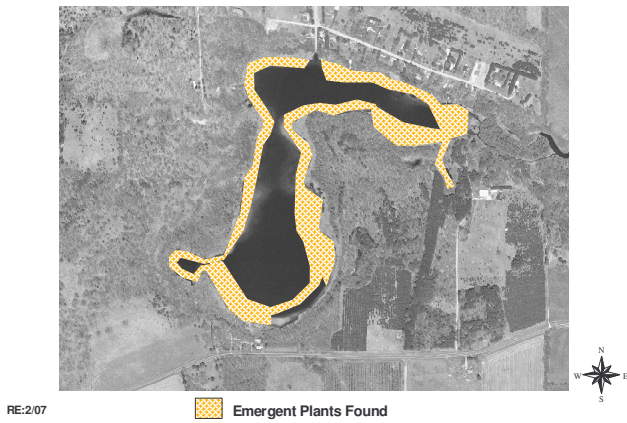


**Purple Loosestrife**

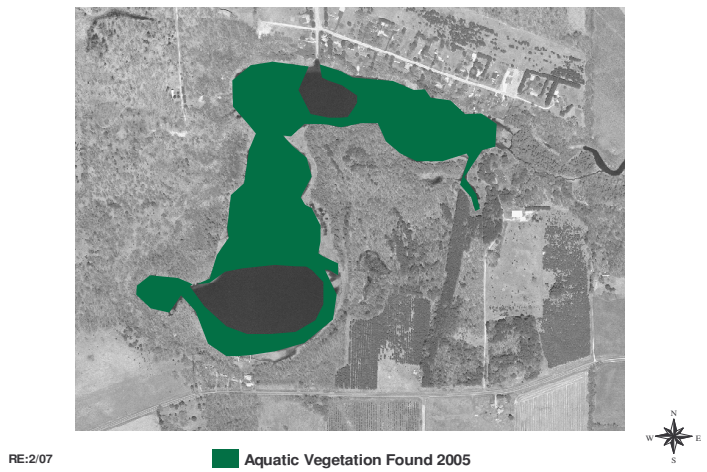


**Eurasian Watermilfoil**

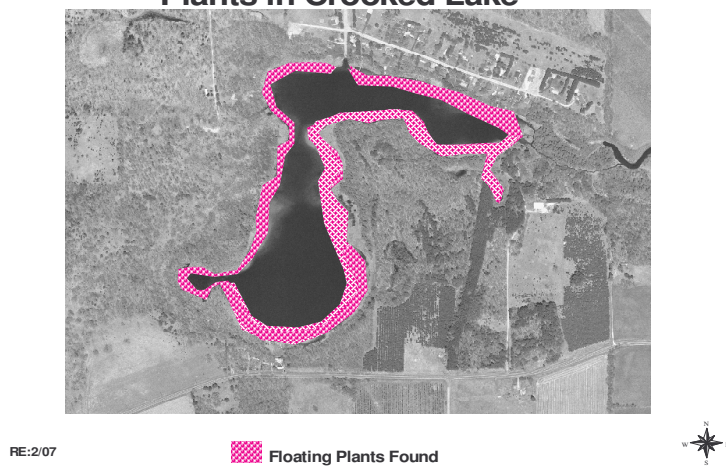
## Emergent Plants in Crooked Lake



## Submergent Vegetation in Crooked Lake

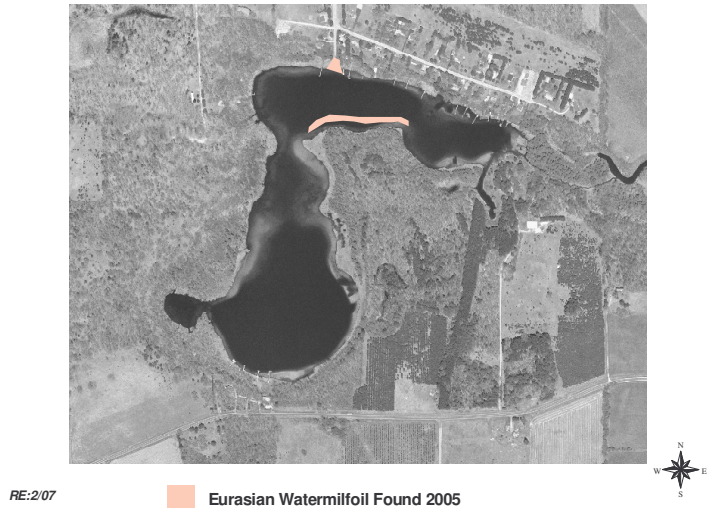


## Floating-Leaf & Free-Floating Plants in Crooked Lake





## Eurasian Watermilfoil in Crooked Lake



### Critical Habitat

Wisconsin Rule 107.05(3)(i)(I) defines a “critical habitat areas” as: “areas of aquatic vegetation identified by the department as offering critical or unique fish & wildlife habitat or offering water quality or erosion control benefits to the body of water. Thus, these sites are essential to support the wildlife and fish communities. They also provide mechanisms for protecting water quality within the lake, often containing high-quality plant beds. Finally, critical habitat areas often can provide the peace, serenity and beauty that draw many people to lakes in the first place.

Three areas on Crooked Lake were determined to be appropriate for critical habitat designation. CR1 extends along approximately 4200 feet of the southwest shoreline of Crooked Lake, up to the ordinary high water mark. A threatened species of aquatic emergents was found in CL1. CL2 extends along approximately 2900 feet of the southeast shoreline. CL3 covers about 3300 feet of the northern and western shore.



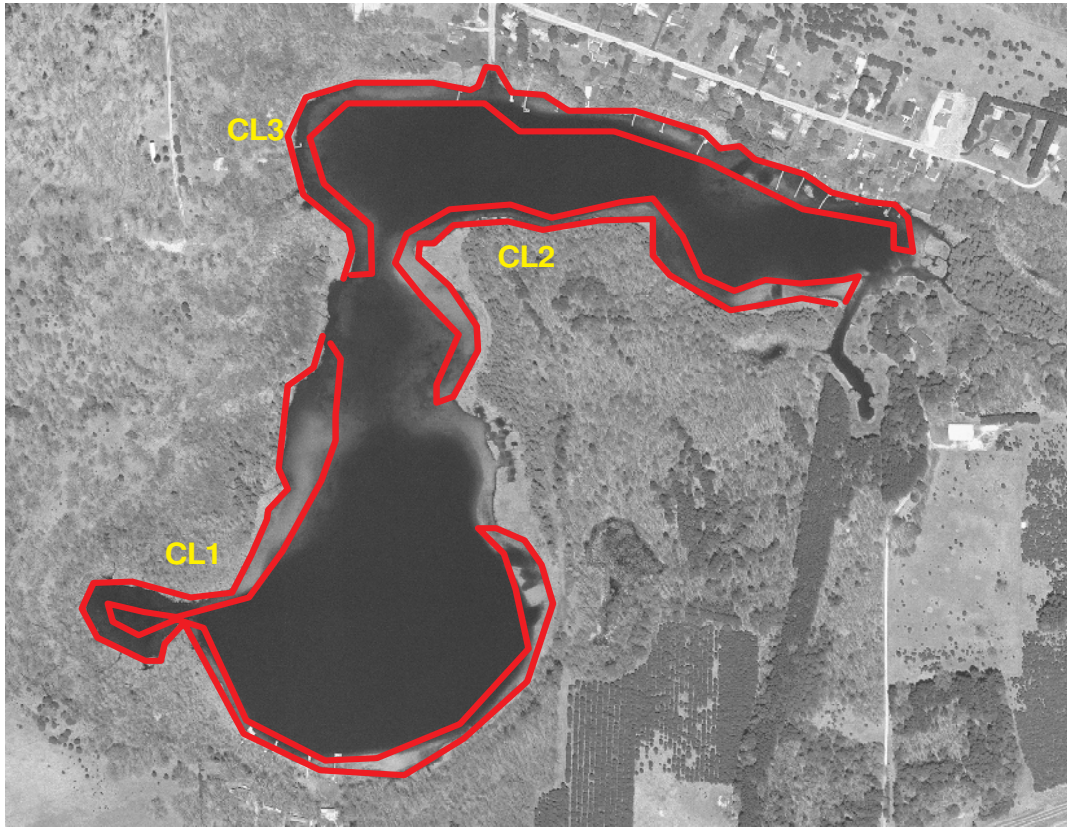
**Part of CL1**



**Part of CL2**



## Critical Habitat Areas--Crooked Lake



RE:6/06



**Part of CL3**

# Fishery/Wildlife/Endangered Resources

Stocking records for Crooked Lake go back to 1937, when northern pike and mixed panfish were stocked by the WDNR. Over the years since, the WDNR also stocked more mixed panfish, perch, largemouth bass, bullhead, northern pike, and both rainbow and brooked trout. Fish inventories from 1954 through 1985 found that largemouth bass, bullheads and panfish were common to abundant, while northern pike tended to be scarce. Trout apparently did not establish a breeding population, since an inventory three years after trout were last stocked found no trout present.

Muskrat and mink are also known to use Crooked Lake shores for cover, reproduction and feeding. A beaver lodge was noted during the critical habitat survey. Seen during the field survey were various types of waterfowl, songbirds, and turkey. Frogs and salamanders are known, using the lake shores for shelter/cover, nesting and feeding. Turtles and snakes also use this area for cover or shelter in this area, as well as nested and fed in this area. Sandhill cranes have also nested on Crooked Lake. Upland wildlife feed and nest here as well.

Crooked Lake Watershed shelters several natural communities designated by the WDNR as communities that are endangered: Calcareous fen; Emergent marsh; Northern sedge meadow; Oak barrens; Open bog; and Southern sedge meadow.



*Eleocharis quadrangulata*

**Squarestem Spikerush**

**Threatened species found at  
Crooked Lake in 2005**



# Recommendations

## **Lake Management Plan**

- By the end of 2008, if not sooner, Crooked Lake Association should develop a lake management plan. The Adams County Land & Water Conservation Department is available for assistance, if requested.
- The lake plan needs to include at least the following aspects concerning the management of the lake: aquatic species management; control/management of invasive species; wildlife and fishery management; nutrient budgeting; shoreland protection; critical habitat protection; water quality protection.

## **Watershed Recommendations**

- Since computer modeling results suggest that input of nutrients, especially phosphorus, are a factor that needs to be explored for Crooked Lake, it is recommended that both the surface and ground watersheds be inventoried, documenting any of the following: runoff from any livestock operations that may be entering the surface water; soil erosion sites; agricultural producers not complying with nutrient management plans and/or irrigation water management plans.
- If such sites are documented, the Crooked Lake Association should encourage Adams County LWCD and landowners to develop and implement plans to address the sites.

## **Water Quality Recommendations**

- All lake residents should practice best management on their lake properties, including keeping septic systems maintained in proper condition and pumped every three years, eliminating the use of lawn fertilizers, cleaning up pet wastes and not composting near the water.
- Reducing the amount of impervious surface around the lake and management of stormwater runoff will also help maintain water quality.
- Residents should become involved in the Citizen Monitoring Programs in water quality and aquatic species, as well as Clean Boats, Clean Waters.
- Lake residents should protect the natural shoreline around Crooked Lake and restore the areas with inadequate buffers. Studies show that disturbed shoreline areas is evidence that shore disturbance is likely to negatively impact the currently excellent aquatic plant community of the lake.

### **Aquatic Plant Recommendations**

- All lake users should protect the aquatic plant community in Crooked Lake by assisting in developing and implementing an integrated aquatic plant management plan that uses multiple methods of control.
- The Crooked Lake Association should maintain exotic species signs at the boat landing.
- The Crooked Lake Association should continue monitoring Eurasian Watermilfoil growth in the lake. If it continues to increase in density and/or frequency, the Lake Association should develop & implement a plan to effectively deal with the infestation.
- Residents should continue to hand-pull scattered EWM plants.
- A milfoil weevil survey should be conducted on Crooked Lake in order to evaluate milfoil weevil availability for assistance in controlling the Eurasian Watermilfoil.
- Shores with inadequate buffers need to restore the buffers to an adequate condition to provide winter habitat for these weevils, as well to assist in maintaining water quality.
- Lake residents should get involved in the county-sponsored Citizen Aquatic Invasive Species Monitoring Program. This will allow not only noting changes in the Eurasian Watermilfoil pattern, but also watch for Curly-Leaf Pondweed and Purple Loosestrife. Noting the presence and density of these plants early is the best way to take preventive action to keep them from becoming a bigger problem.

### **Critical Habitat Recommendations**

- Maintain current habitat for fish and wildlife. Maintain wetlands undisturbed.
- Leave fallen trees along shoreline & in water.
- No alteration of littoral zones unless necessary to improve habitat.
- Seasonal protection of spawning habitat.
- Maintain the wildlife corridor. Also maintain snag/cavity trees & nest boxes.
- Maintain sedge meadow/marsh areas.
- Protection emergent vegetation.
- Seasonal control of exotics.
- No bank grading or grading of adjacent land.
- Disturb the vegetated shores as little as possible to maintain their integrity.
- Maintain aquatic vegetation in undisturbed condition for wildlife habitat, fish use and water quality protection.